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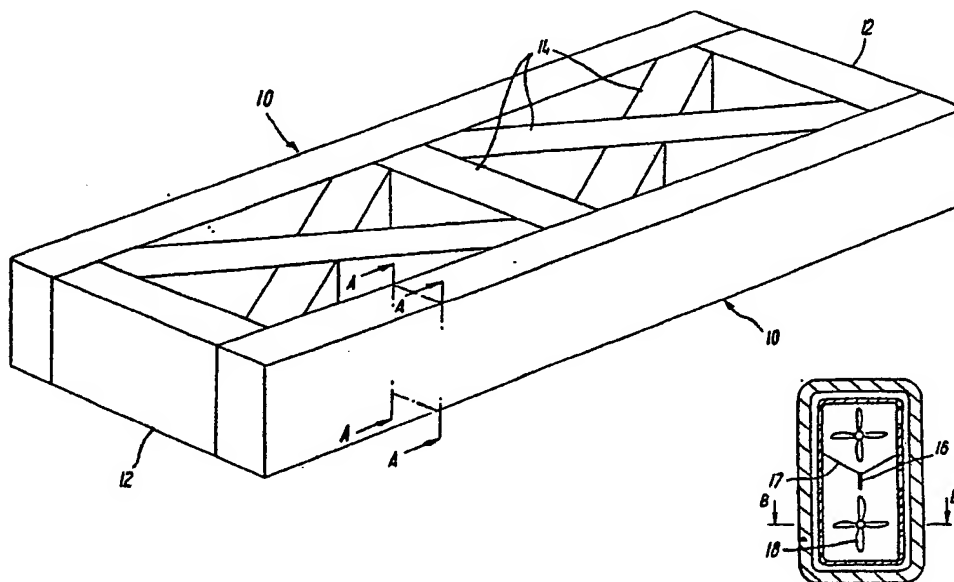
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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: PCT/GB89/00347 (22) International Filing Date: 5 April 1989 (05.04.89) (30) Priority data: 8808281.3 8 April 1988 (08.04.88) GB (71) Applicant (for all designated States except US): L.K. TOOL COMPANY LIMITED [GB/GB]; East Midlands Airport, Castle Donington, Derby DE7 2SA (GB). (72) Inventor; and (75) Inventor/Applicant (for US only) : BURY, James [GB/GB]; 109 Woodlands Road, Allestree, Derby DE3 2HH (GB). (74) Agent: DREVER, Ronald, Fergus; Swindell & Pearson, 48 Friar Gate, Derby DE1 1GY (GB).		(81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), FR (European patent), GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US. Published <i>With international search report.</i>

(54) Title: SUPPORT STRUCTURES



(57) Abstract

In a co-ordinate measuring machine a guideway base is formed from tubular components (10-14) of a lightweight material. An electrically heated strip (16) is located centrally of the tubular elements and fans (18) are also provided within the base. The strip (16) and the fans (18) can maintain the temperature of the base structure at a constant level at or above the ambient temperature so that changes in the latter do not result in any thermal expansion of the material of the base structure.

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Support Structures

This invention relates to apparatus for supporting components and is particularly but not exclusively concerned with support structures for use with high accuracy measuring and checking machines.

Heretofore for purposes of accuracy, it has been necessary to construct co-ordinate measuring machines using heavyweight material such as granite, i.e. material which remains as stable as possible with variations in temperature. It has not been practical to use lightweight base structures where thermal expansion of the material could lead to distortion and loss of accuracy.

According to the present invention there is provided support apparatus comprising elongate means having a through passage, heating means provided in the passage, and means for controlling the heating means whereby to be capable of maintaining the temperature of the apparatus at a level at or above the ambient temperature.

Preferably the heating means comprises one or more electrically heated strips which can be located centrally in the passage.

Preferably also the elongate means comprises a

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plurality of linear tubular elements connected together in a rectangular configuration, particularly to form a base guideway of a measuring machine.

The elongate means may be formed of a lightweight material such as steel or a granite composite material, and external insulation may be provided.

Fan means may be provided within the elongate tubular means to move air therethrough and thereby assist in providing an even distribution of temperature throughout the apparatus.

An embodiment of the present invention will now be described by way of example only with reference to the single figure of the accompanying drawings, in which:-

Fig. 1 is a diagrammatic perspective view of an apparatus according to the invention;

Fig. 2 is an enlarged section on AAAA of Fig. 1;
and

Fig. 3 is a section on B-B of Fig. 2.

Referring to the drawing, a guideway base for use in a three axis co-ordinate measuring machine comprises a first pair of elongate tubular components 10 interconnected

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at their respective ends by a pair of tubular components 12 of reduced length whereby to define a rectangular configuration with a continuous passage therethrough. To reinforce the base an arrangement of elongate tubular struts 14 extend between inwardly facing external walls of the elements 10,12 in any suitable arrangement. The elements 10,12 and the struts 14 are formed of a lightweight material, preferably steel or a granite composite material comprising granite chippings and epoxy.

To heat the base, a strip 16 incorporating one or more resistance wires is located within the elements 10,12 and the struts 14 to extend around the base. The strip 16 is preferably located centrally of the elements 10,12 by being suspended by arms 17 from side walls thereof, so as to avoid creating temperature gradients in the walls of the elements 10,12. The strip 16 is appropriately connected in an electrical circuit (not shown) for heating of the strip and thereby the base.

Additional heating strips may be used as necessary and in a modification the strip 16 may not extend around the whole base.

Within the base in the through passage there is provided a plurality of electrically operated fans 18. These

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effect circulation of the heated air throughout the base and thereby assist in providing a substantially uniform temperature throughout.

External insulation is provided for the elements 10,12 in order to avoid a temperature gradient across the walls. The insulation may be in a spaced relation with the external walls of the elements 10,12 to provide an air layer and it is envisaged that there may be provision for air to exit from the passage in the base into the spacing between the external walls and the insulation layer.

In use, the heating circuit controls the heating strip such that the temperature of the base structure is maintained at a constant level, at or above the ambient temperature. In this way changes in the ambient temperature do not result in any thermal expansion of the material of the base structure and therefore distortion and loss of measuring accuracy can be avoided.

Various modifications may be made without departing from the invention. For example the configuration of the base structure may differ from that described and shown and other suitable heating means may be provided internally of the elements. Also the structure may be formed of any other suitable material, and may be other than a machine

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base. For example the structure may take the form of a column and/or bridge of a co-ordinate measuring machine.

It is particularly suitable to use such a lightweight base structure with a support as described in our co-pending U.K. Application No. 8808282 entitled "Support Assemblies", a lightweight structure for the other components of the machine as described in our co-pending U.K. Application No. 8808280 entitled "Machine Structure", and a linear guideway as described in our co-pending U.K. Application No. 8808279 entitled "Linear Guiding Apparatus".

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Claims:-

1. Support apparatus comprising elongate means having a through passage, heating means provided in the passage, and means for controlling the heating means whereby to be capable of maintaining the temperature of the apparatus at a level at or above the ambient temperature.
2. Apparatus according to Claim 1, wherein the heating means comprises one or more electrically heated strips.
3. Apparatus according to Claim 2, wherein the heated strips are located centrally in the passage.
4. Apparatus according to any of Claims 1 to 3, wherein the elongate means comprises a plurality of linear tubular elements connected together in a rectangular configuration.
5. Apparatus according to any of the preceding Claims, wherein the elongate means is formed of a lightweight material.
6. Apparatus according to Claim 5, wherein the material is steel.
7. Apparatus according to Claim 5, wherein the material

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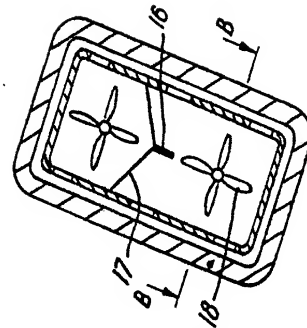
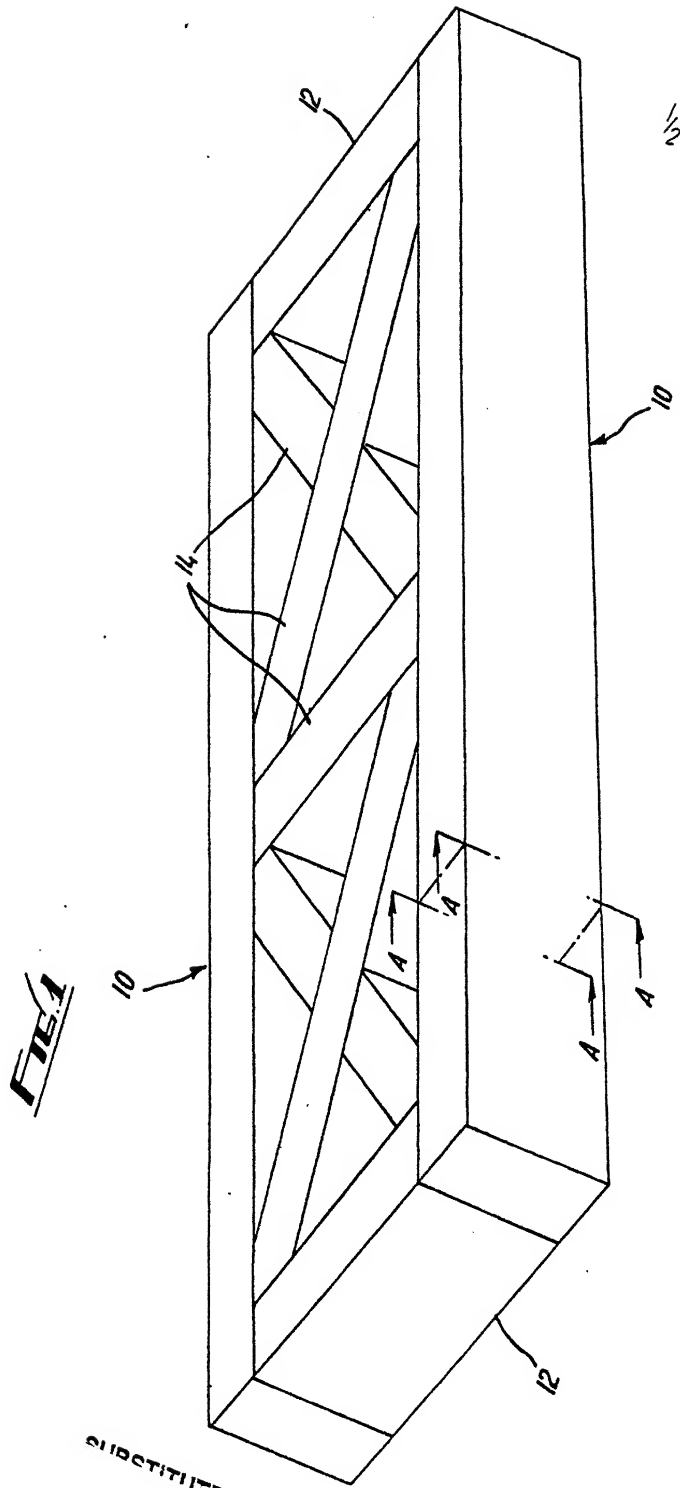
is a granite composite material.

8. . Apparatus according to any of the preceding Claims, wherein external insulation is provided.

9. Apparatus according to any of the preceding Claims, wherein fan means is provided within the elongate tubular means to move air therethrough and thereby assist in providing an even distribution of temperature throughout the apparatus.

10. Support apparatus substantially as hereinbefore described with reference to the accompanying drawings.

11. Any novel subject matter or combination including novel subject matter herein disclosed in the foregoing Specification or Claims and/or shown in the drawings, whether or not within the scope of or relating to the same invention as any of the preceding Claims.



SUBSTITUTE SHEET

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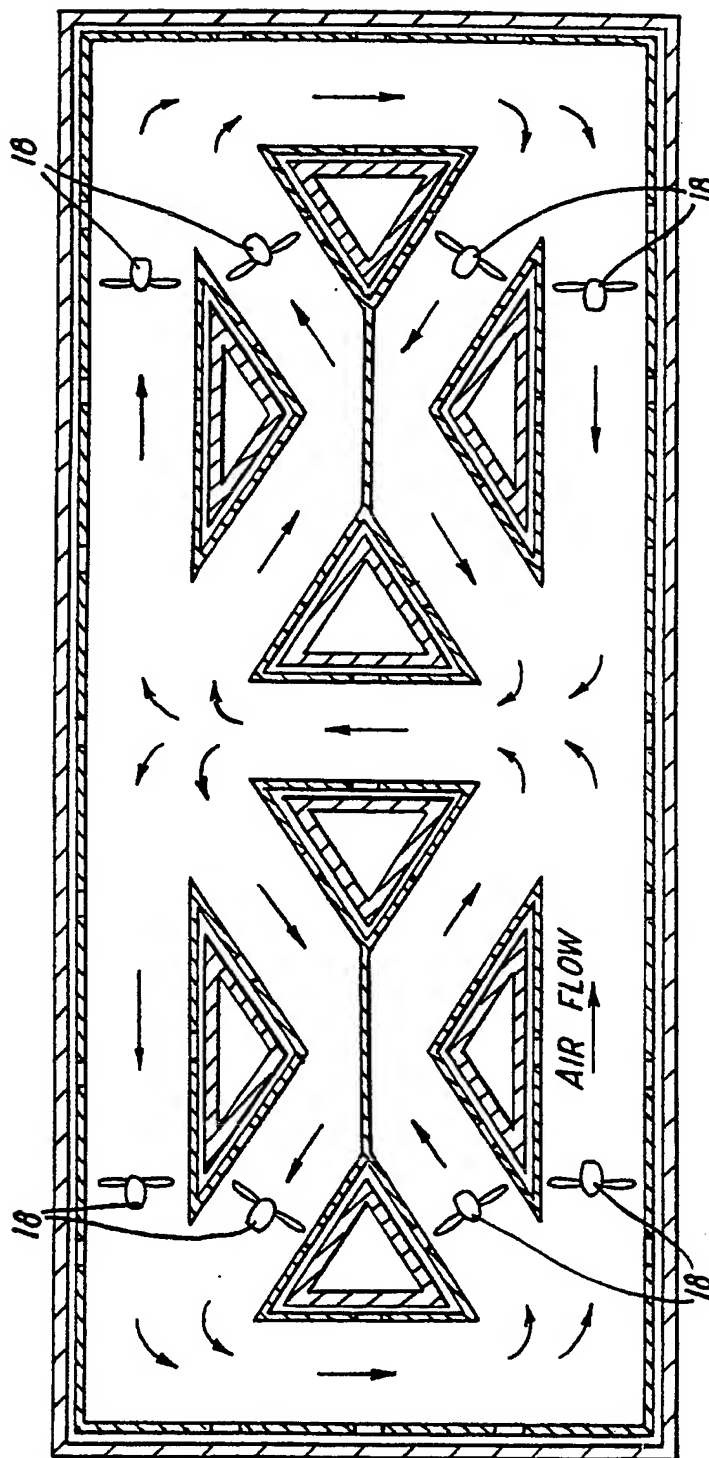



FIG. 3

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 89/00347

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC ⁴ : G 01 B 5/00, B 23 Q 11/14		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
IPC ⁴	G 01 B 5, B 23 Q 11	
Documentation Searched other than Minimum Documentation to the extent that such Documents are included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹		
Category ⁹	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	Patent Abstracts of Japan, vol. 8, no. 210 (M-328)(1647), 26 September 1984, & JP, A, 5997823 (FUJI JUKOGYO K.K.) 5 June 1984 see abstract; figure --	1,4
X	FR, A, 1271581 (ATELIERS G.S.P.) 15 September 1961 see the whole document --	1,2,9
X	WO, A, 83/02740 (THE GLEASON WORKS) 18 August 1983 see page 5, line 9 - page 8, line 5 --	1,4
A	DE, A, 3437196 (POTULSKI) 15 May 1986 see column 6, line 59 - column 5, line 12 --	1,8,9
A	DE, A, 3325387 (DAIMLER-BENZ) 31 January 1985 see page 6, line 30 - page 12, line 15 --	1,4
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>* Special categories of cited documents: ¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p> </div> </div>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
17th July 1989	27 JUL. 1989	
International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE	 P.C.G. VAN DER PUTTEN	

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III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	GB, A, 2114924 (INOUE-JAPAX) 1 September 1983 see the whole document --	1,2,4,8,9
A	Forest Products Journal, vol. 8, no. 7, July 1958, A.O. Fiehl: "Reducing heat distortion in the knife and pressure bar assemblies of veneer lathes", pages 216-218 see page 217, right-hand column -----	1,2

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.**

GB 8900347
SA 28033

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on 20/07/89
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR-A- 1271581		None	
WO-A- 8302740	18-08-83	EP-A- 0101456	29-02-84
DE-A- 3437196	15-05-86	None	
DE-A- 3325387	31-01-85	None	
GB-A- 2114924	01-09-83	None	